

## Four new species of earthworms belonging to the genus *Amyntas* (Oligochaeta: Megascolecidae) from Diaoluo Mountain, Hainan Island, China

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**Four new species of earthworms belonging to the genus *Amyntas* (Oligochaeta: Megascolecidae) from Diaoluo Mountain, Hainan Island, China.** - This paper describes four new species of earthworms from Hainan Island, China: *Amyntas diaoluomontis* sp. nov., *Amyntas octopapillatus* sp. nov., *Amyntas zhangii* sp. nov. and *Amyntas lingshuiensis* sp. nov. All four species have two pairs of spermathecal pores in 5/6-6/7, simple paired caeca from XXVII and some papillae in the male pore region. The four new species are easily distinguished from other similar *Amyntas* species, especially those of the provisional *morrisi* species-group.

**Keywords:** Earthworms - *Amyntas* - Megascolecidae - Clitellata - new species - Hainan - China.

### INTRODUCTION

Hainan is a large tropical island in southern China with a diverse endemic flora and fauna (Deng *et al.*, 2008). The major sites of virgin tropical forests are located in Jianfeng Ridge, Five Fingers Mountain, Diaoluo Mountain, Limu Mountain, and Macaque Ridge. The earliest research on earthworms from Hainan Island was carried out by Chen Yi (1938), who reported 32 species, 22 of which were described as new. This Hainan earthworm fauna is clearly distinct from other regions in China, leading Chen (1956) to hypothesize that Hainan Island has been separated from the mainland for a long time. More recently, Quan (1985) and Quan & Zhong, (1989) reported three new earthworm species from Hainan. In this paper we report new earthworm species collected from Diaoluo Mountain during a fieldtrip in June 2006.

### MATERIAL AND METHODS

Diaoluo Mountain National forest park (about 18°50'N 109°50'E) is located in the southeast of Hainan island. The climate is typical monsoonal, with a distinct dry season from November to January, a transition period from February to March, and a rainy season from April to October. Ninety-six percent of the total annual rain falls

during the rainy season. Soils in the area include latosols below 300 meter and mountain zheltozem at higher elevations (Wang & An, 1999).

Material was collected by digging and hand sorting. Specimens were preserved in formalin. Descriptions are based on dorsal dissections. The species were determined to be new based on comparisons to all the species of the *morrisi*-group (Beddard, 1892, 1895, 1896; Chen, 1933, 1936, 1938, 1946; Gates, 1926, 1936; Kobayashi, 1936, 1938; Michaelsen, 1892, 1923, 1927; Rosa, 1894; Sims & Easton, 1972). We provide a table to compare the four new species to similar species previously found in Hainan Island (Table 1).

Holotypes and paratypes are deposited in the Shanghai Natural Museum (MNS) and the Natural History Museum of Geneva (MHNG).

## DESCRIPTIONS

*Amyntas diaoluomontis* Qiu & Sun sp. n.

Fig. 1

**MATERIAL:** Holotype, one clitellate (MNS C-HN001A); China, Hainan Island, Mt. Diaoluo (18°43'39"N 109°51'55"E), 930 m, 6 June 2006, J. P. Qiu & M. B. Bouché colls. – 17 paratypes; 15 clitellates (MNS C-HN001B), 2 clitellates (MHNG INVE62881), same data as for holotype. – Nontype material; Mt. Diaoluo (18°43'45"N 109°51'50"E), 1008 m, zheltozem under rotten trees in cinnamomum camphora, 8 a clitellate specimens, 6 June 2006.

**ETYMOLOGY:** The species is named for its type locality.

**EXTERNAL CHARACTERS:** Preserved specimens lacking pigment on dorsum and ventrum. Dimensions 135-189 mm by 3.9-4.8 mm at clitellum, segments number 213-237. Secondary annulations conspicuous in segments V-XXXVI. Prostomium combined probolous and 1/3 epilobous. First dorsal pore in 12/13. Setae numerous, 56-78 at III, 72-94 at V, 72-106 at VIII, 44-66 at XX, 48-66 at XXV; 9-13 between male pores; 18-32 between spermathecal pores, setal formula: aa=1.1-1.2ab, zz=1.2-2zy. Clitellum annular, reddish-brown colour, in XIV-XVI, setae visible externally, particularly evident on ventrum.

Spermathecal pore: two pairs in 5/6-6/7, ventral, eye-like, 0.25 body circumference apart from each other. Genital markings not present.

Male pores: one pair in XVIII, 0.33 body circumference ventrally apart from each other, each on the centre of a slightly raised, conical, glandular porophore, without circular folds. Male field genital papillae ovate, flat-topped, diameter 0.8-1.2 mm, paired on 17/18, 18/19 median to male pores (Figure 1A).

Female pore: one in a small ovoid tubercle, mid-ventral in XIV, lighter colour than surroundings.

**INTERNAL CHARACTERS:** Septa 5/6-7/8 thick and muscular, 10/11-14/15 slightly thickened, 8/9-9/10 absent. Gizzard ball-shaped, in VIII-IX according to septum 7/8. Intestine enlarged distinctly from XVI. Intestinal caeca paired in XXVII, simple, smooth, with two indentations on dorsal edge, extending anteriorly to XXVI. Esophageal hearts in X-XIII.

Spermathecae two pairs in VI-VII, ampulla ovoid, about 2 mm long with a slender duct about equally long. Diverticulum a little shorter than main pouch, slender, a distorted circle, terminal 0.6 dilated into a band shaped chamber, partially filled, milky white (Figure 1B).

TABLE 1. A comparison of characters between these four new species and other similar species with two pairs of spermathecal pores in 5/6 and 6/7

Character	<i>A. diaoluomontis</i>	<i>A. octopapillatus</i>	<i>A. shangi</i>
Size (mm)	135-189/3.9-4.8	123-138/3.0-3.5	124-200/3.1-5.3
Segments papillae	213-237 Paired 0.8-1.2 mm oval flat-topped papillae on 17/18/19 median in male pores	139-205 Paired 0.6-0.8 mm oval papillae on 17/18/19/20/21 median to male pores	186-206 Paired 0.8-1.0 mm round papillae on XVII and XIX in line with male pores
Spermathecal pores	0.25 body circumference apart from each other	0.25 body circumference apart from each other	About 0.5 body circumference apart from each other
Diverticulum	A little shorter than main pouch, with a band-shaped chamber	Longer than main pouch by 1/5 with a tube-shaped chamber	Shorter than main pouch by 1/4, with a pear-shaped chamber
First dorsal	12/13	12/13	12/13
Testis sacs	First pair of seminal vesicles not enclosed in testis-sacs	Seminal vesicles in XI enclosed in testis sacs of that segment	Seminal vesicles in XI enclosed in testis-sacs of that segment
Character	<i>A. lingshuiensis</i>	<i>A. puerilius</i>	<i>A. hainanicus</i>
Size (mm)	76-132/2.7-3.1	20-37/1.2	50/1.8
Segments papillae	123-153 Paired 0.3 mm oval flat-topped papillae on XVIII and XIX above setae annulet. The first pair is 0.17 body circumference apart from other and the second pair is 0.25. The four papillae form a trapezoid	47-72 paired small papillae on XVII	110 No papilla
Spermathecal pores	0.33 body circumference apart from each other	About 0.5 body circumference apart from each other	0.2 body circumference apart from each other
Diverticulum	Longer than main pouch by 1/5, with a band-shaped distal seminal chamber	Shorter than main pouch with short conical chamber	Longer than main pouch with thin-walled chamber
First dorsal	12/13	11/12	12/13
Testis sacs	Seminal vesicles in XI enclosed in testis sacs of that segment	First pair of seminal vesicles not enclosed in testis-sacs	Seminal vesicles in XI enclosed in testis sacs of that segment

Character	<i>A. oculatus</i>	<i>A. monoseriali</i>	<i>A. sinuosus</i>
Size (mm)	27-40/1.2-1.8	52-150/3-4	170-240/4-5
Segments papillae	74-86 Paired large disc-like papillae on 118/19 behind each male pore	136-146 Ventre-medial papillae on XVI-XX, generally postsetal	168-205 Paired raised papillae on XVII and XIX in line with male pores
Spermathecal pores	0.43 body circumference apart from each other	0.33 body circumference apart from each other	0.33 body circumference apart from each other
Diverticulum	Longer than main pouch, its ventral 0,8 whitish as seminal chamber	Long or shorter, with an ovoid seminal chamber	Shorter than main pouch by 1/4, with a zigzag twisted chamber
First dorsal	12/13	12/13	12/13
Testis sacs	Seminal vesicles in XI enclosed in testis sacs of that segment	Seminal vesicles in XI enclosed in testis sacs of that segment	Seminal vesicles in XI enclosed in testis sacs of that segment

Holandric: testis sacs two pairs, well-developed, ventral in X, XI, in close proximity, but separated from each other. Seminal vesicles paired in XI-XII, anterior pair bigger in size, none enclosed in testis sacs. Prostate glands developed, extending from XVI-XX, coarsely lobate. Prostatic duct U-shaped, slightly thicker at the distal part. No accessory glands present.

LOCALITY AND HABITAT: The specimens were collected from the zheltomez, under bushes by the roadside and the humus layer under trees of Diaoluo Mountain, Hainan province, China.

REMARKS: After comparing to the *Amyntas* species reported from China and Southeast Asia with two pairs of spermathecal pores in 5/6 and 6/7 and with one pair of spermathecal pores in 5/6 (Chang & Chen, 2004; Chen, 1931, 1933, 1936, 1938, 1946; Chen *et al.*, 1975; Chen & Hsu, 1977; Ding, 1985; Gates, 1935, 1939a, 1939b, 1972; Hong *et al.*, 2001; Hong & James, 2001, 2004, 2008; Hong, 2007; James, 2004; James *et al.*, 2004; James *et al.*, 2005; Qiu & Wen, 1987; Shen *et al.*, 2003; Tsai *et al.*, 2000; Tsai *et al.*, 2001; Tsai *et al.*, 2004; Tsai *et al.*, 2007) we find the present species to be most similar to *Amyntas tetrapapillatus* (Quan & Zhong, 1989). However, they differ with respect to the number of spermathecae, shape of spermathecal diverticulum, location of first dorsal pores, pigmentation, and enclosure of testes in sacs. *Amyntas diaoluomontis* sp. nov. has two pairs of spermathecae in VI and VII, a straight diverticulum stalk, the first dorsal pore in 12/13, no pigmentation and the first pair of seminal vesicles is not enclosed in the second pair of testis sacs. In contrast, *Amyntas tetrapapillatus* has only one pair of spermathecae in VI, a zigzag looped diverticulum

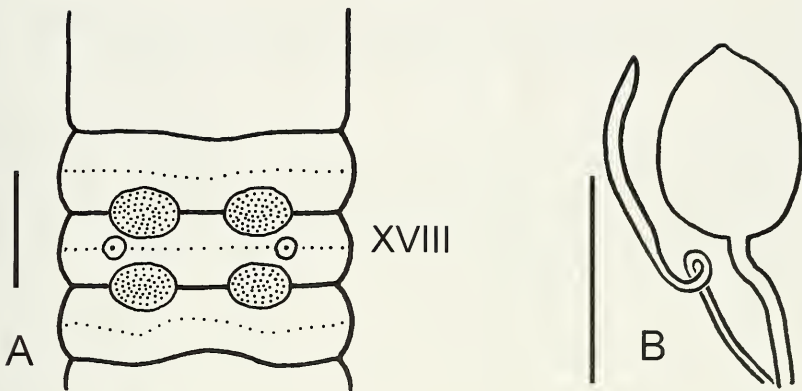


FIG. 1

*Amyntas diaoluomontis* spec. nov. (A) External view of ventral side with male pores, XVIII = segment number; scale bar 1 mm. (B) Spermatheca, scale bar 1 mm.

stalk near the seminal chamber, the first dorsal pore in 11/12, light maroon pigment on ventrum and dorsum, and the first pair of seminal vesicles contained in the second pair of testis sacs.

A comparison of characters between this new species and other similar species with two pairs of spermathecal pores in 5/6 and 6/7 collected from Hainan has been given in Table 1.

*Amyntas octopapillatus* Qiu & Sun sp. n.

Fig. 2

**MATERIAL:** Holotype, one clitellate (MNS C-HN002A); China, Hainan Island, Mt. Diaoluo (18°43'39" N 109°51'55" E), 930 m, 6 June 2006, J. P. Qiu & J. X. Li colls. – 3 paratypes, 1 clitellate (MNS C-HN002B), 2 clitellates (MHNG INVE62882); same data as for holotype. – Nontype material; same data as for holotype, 2 semiclitellate specimens.

**ETYMOLOGY:** The species name refers to its eight papillae.

**EXTERNAL CHARACTERS:** Preserved specimens lacking pigment on dorsum and ventrum, clear dorsal midline because of dorsal vessel. Dimensions 123-138 mm by 3.0-3.5 mm at clitellum, segments number 139-205. Secondary annulations conspicuous in both anterior segments and others. Prostomium ? epilobous. First dorsal pore in 12/13. Setae numerous, 56-70 at III, 74-92 at V, 68-90 at VIII, 64-66 at XX, 56-68 at XXV; 14-20 between male pores; 13-19 between spermathecal pores, setal formula: aa=1.1-1.4ab, zz=1.3-2zy. Clitellum annular, swollen, brownish, in XIV-XVI, setae and intersegmental furrow visible externally. 30 of them can be clearly seen on ventrum.

**Spermathecal pores:** two pairs in 5/6-6/7, intersegmental, ventral, eye-like. 0.25 body circumference apart from each other. Genital markings not present.

**Male pores:** paired in XVIII, 0.33 body circumference ventrally apart from each other, each on the centre of a slightly raised, conical, glandular porophore, with 1-2 circular folds. Paired 0.6-0.8 mm oval papillae on 17/18/19/20/21 median to level of male pores (Figure 2A).

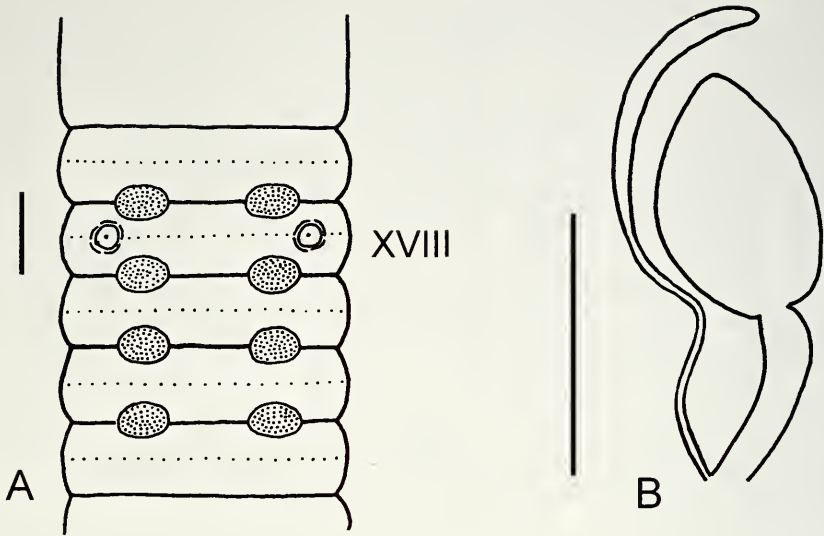


FIG. 2

*Amyntas octopapillatus* spec. nov. (A) External view of ventral side with male pores, XVIII = segment number; scale bar 1 mm. (B) Spermatheca, scale bar 1 mm.

Female pore: one in a small ovoid tubercle, mid-ventral in XIV.

INTERNAL CHARACTERS: Septa 6/7-7/8 thick and muscular, 10/11-13/14 slightly thickened, 8/9-9/10 absent. Gizzard bucket-shaped, in VIII-IX according to septum 7/8. Intestine enlarged distinctly from XVI. Intestinal caeca paired in XXVII, simple, smooth, extending anteriorly to XXIV. Esophageal hearts in X-XIII.

Spermathecae two pairs in VI-VII, heart-shaped, about 1.8 mm with a long duct. Diverticulum is longer than main pouch by 1/5, no kinks, terminal 1/2 dilated into a tube-shaped chamber, partially filled, silvery white (Figure 2B).

Holandric: testis sacs two paired, in X-XI, anterior pair larger, sacs of a segment very close ventrally, second pair enclosing first pair of seminal vesicles. Seminal vesicles paired in XI-XII, well developed. Prostate glands developed, extending from 0.33XVI-0.33XX, coarsely lobate. Prostatic duct U-shaped, slightly thicker at the distal part. Accessory glands not seen.

LOCALITY AND HABITAT: The specimens were collected in Malacosoma marina under the fallen trees and camphor forests of Diaolu mountain (elevation 930m, 18°43'39"N 109°51'55"E), Hainan province, China.

REMARKS: In appearance, *Amyntas octopapillatus* sp. nov. is somewhat similar to *Amyntas diaoluomontis* sp. nov. Both species have two pairs of spermathecal pores in 5/6 and 6/7, no pigment, and the shape of the papillae on the ventrum. However, *Amyntas octopapillatus* sp. nov. is distinguished from *Amyntas diaoluomontis* sp. nov. by its smaller body size, its two additional pairs of papillae on 19/20/21, and by having the first pair of seminal vesicles enclosed in the second pair of testis sacs.

A comparison of characters between this new species and other similar species with two pairs of spermathecal pores in 5/6 and 6/7 collected from Hainan is given in table 1.

*Amyntas zhangii* Qiu & Sun sp. n.

Fig. 3

**MATERIAL:** Holotype, one clitellate (MNS C-HN003A); China, Hainan Island, Mt. Diaoluo (18°43'30"N 109°52'07"E), 920 m, 6 June 2006, J. P. Qiu & X. L. Zhang colls. – 2 paratypes, 2 clitellates (MHNG INVE62883); same data as for holotype. – Nontype material; Mt. Diaoluo (18°43'45"N 109°51'50"E), 920 m, 18 acitellate specimens, 6 June 2006.

**ETYMOLOGY:** The species is named in honour of its collector, Xiaolong Zhang.

**EXTERNAL CHARACTERS:** Preserved specimens grayish on dorsum before clitellum, light brownish on dorsum after clitellum. Dimensions 124-200 mm by 3.1-5.3 mm at clitellum, segments number 186-206. Secondary annulations conspicuous in segments V-XIII. Prostomium combined prolobous and ? epilobous. First dorsal pore in 12/13. Setae numbering, 50-64 at III, 60-76 at V, 64-70 at VIII, 60-70 at XX, 60-70 at XXV; 4-6 between male pores; 33-35 between spermathecal pore, setae formula: aa=1.1-2ab, zz=1.5-2zy. Clitellum annular, brownish, thinly glandular, intersegmental furrows clear, in XIV-XVI, 20-28 setae visible externally, evident only on ventrum.

Spermathecal pores paired in 5/6-6/7, eye-like, about 0.5 body circumference apart from each other. Genital markings not present.

Male pores: one pair in XVIII, 0.33 body circumference ventrally apart from each other, each on the top centre of a slightly raised, conical porophore, with two circular folds not very clear. In XVII and XIX, in line with male pores, there are paired large round papillae, diameter 0.8-1.0 mm (Figure 3A).

Female pore: single, midventral in a small ovoid tubercle, in XIV.

**INTERNAL CHARACTERS:** Septa 5/6-7/8 thick and muscular, 10/11-12/13 slightly thickened, 8/9-9/10 absent. Gizzard long ball-shaped, in VIII-IX according to septum 7/8. Intestine enlarged distinctly from XVI. Intestinal caeca paired in XXVII, simple, slender, smooth, extending anteriorly to XXV. Esophageal hearts in X-XIII.

Spermathecae two pairs in VI-VII, lanceolate, yellowish, about 1.9 mm long with a slender terminal duct about equally long. The length of diverticulum is 3/4 length of main pouch, in zigzag fashion, terminal 1/7-1/6 dilated into pear-shaped chamber, with pointed tip, partially filled (Figure 3B).

Holandric: testis sacs two pairs, undeveloped, in X-XI, second pair enclosing first pair of seminal vesicle. Seminal vesicles paired in XI-XII, small. Prostate glands small, extending from 0.75XVII-0.75XIX, coarsely lobate. Prostatic duct S-shaped, slender. No accessory glands present.

**LOCALITY AND HABITAT:** The specimens were collected in the cinnamon soil found under oleander trees and bushes of Diaoluo Mountain, Hainan province, China.

**REMARKS:** In comparison to the other species of the *morrisoni*-group reported from China and Southeast Asia (Sims & Easton, 1972), we find *Amyntas zhangii* sp. nov. is similar to *Amyntas sinuosus* (Chen, 1938) because both have two pairs of spermathecal pores in 5/6 and 6/7, a rather big body, the diverticulum zigzag twisted, and paired raised papillae in XVII and XIX in line with male pores. However, they differ

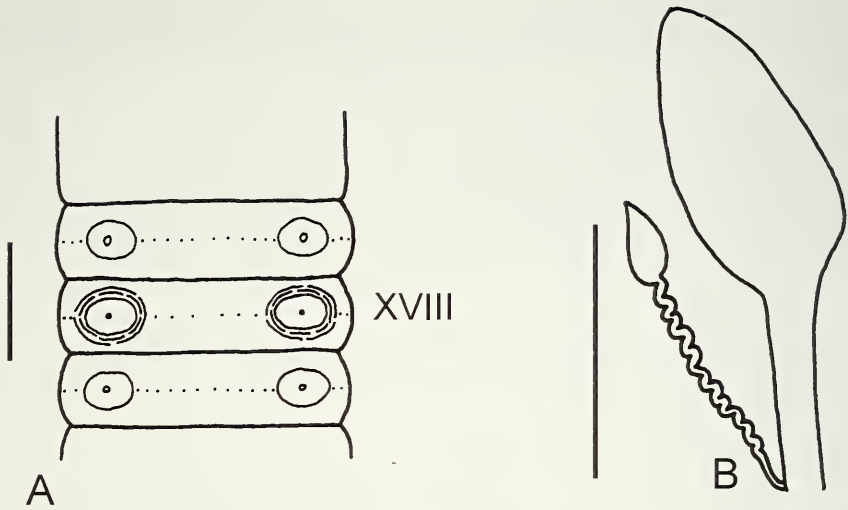


FIG. 3

*Amynthes zhangii* spec. nov. (A) External view of ventral side with male pores, XVIII = segment number; scale bar 1 mm. (B) Spermatheca, scale bar 1 mm.

markedly in that the male pores of *A. Zhangii* do not have a lateral skin fold covering the pores, the diverticulum seminal chambers being oval, and the male organs being small and somewhat reduced. The male pores of *Amynthes sinuosus* are partly covered by a lateral skin fold, the seminal chambers are not oval-shaped, and the prostatic glands and other male organs are well-developed.

A comparison of character between this new species and other similar species with two pairs of spermathecal pores in 5/6 and 6/7 collected from Hainan is given in Table 1.

*Amynthes lingshuiensis* Qiu & Sun sp. n.

Fig. 4

MATERIAL: Holotype, one clitellate (MNS C-HN004A); China, Hainan Island, Mt. Diaoluo (18°44'08"N 108°52'07"E), 850 m, 4 June 2006, J. P. Qiu & W. X. Zhang colls. – 5 paratypes, 3 clitellate (MNS C-HN004B), 2 clitellate (MHNG INVE62884); same data as for holotype.

ETYMOLOGY: The specific epithet refers to the type locality.

EXTERNAL CHARACTERS: Preserved specimens lacking pigment on dorsum, light brown on ventrum, having purple dorsal midline, can be seen clearly. Dimensions 76–113 mm by 2.7–3.1 mm at clitellum, segments number 123–153. Prostomium  $\frac{1}{2}$ epilobous. First dorsal pore in 12/13. Setae numerous, 44–60 at III, 44–54 at V, 48–52 at VIII, 38–46 at XX, 44–50 at XXV; 5–7 between male pores; 19–23 between spermathecal pores, setal formula: aa=1-1.3ab, zz=1.3-2.2zy. Clitellum annular, swollen, light reddish, in XIV–XVI, setae and dorsal pore invisible.

Spermathecal pores: two pairs in 5/6–6/7, intersegmental, ventral, eye-like, 0.33 body circumference apart from each other. Genital markings not present.



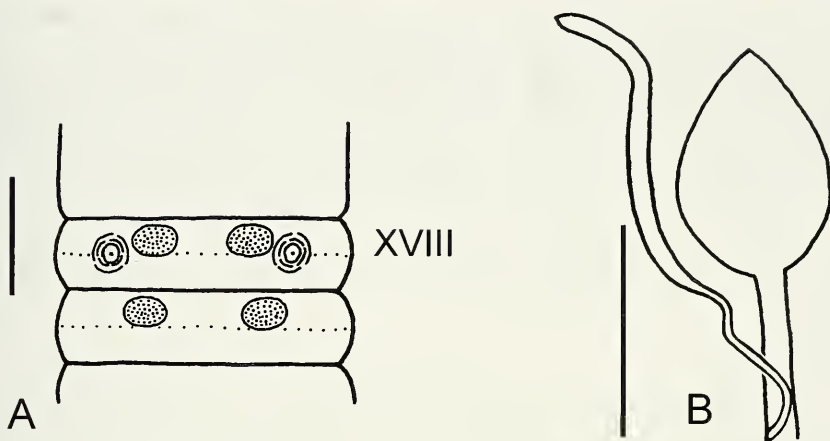


FIG. 4

*Amynthus lingshuiensis* spec. nov. (A) External view of ventral side with male pores, XVIII = segment number; scale bar 1 mm. (B) Spermatheca, scale bar 1 mm.

Male pores: one pair in XVIII, 0.33 body circumference ventrally apart from each other, each on the centre of a slightly raised, conical porophore, with 2-3 circular folds. Male field genital papillae ovoid, flat-topped, diameter 0.3 mm; paired above setae annulet on XVIII and XIX. The first pair is 0.17 body circumference apart from each other and the second pair is 0.25. The four papillae form a trapezoid (Figure 4A).

Female pore: one in a small ovoid tubercle, mid-ventral in XIV.

INTERNAL CHARACTERS: Septa 6/7-7/8 thick and muscular, 10/11-12/13 slightly thickened, 8/9-9/10 absent. Gizzard long bucket-shaped, in VIII-IX according to septum 7/8. Intestine enlarged gradually from XVI to XX and enlarged suddenly from XXI. Intestinal caeca paired in XXVII, simple, smooth, extending anteriorly to XXV. Esophageal hearts in X-XIII.

Spermathecae two pairs in VI-VII, ampulla heart-shaped, about 1.9 mm with about equal duct. Diverticulum is longer than main pouch by 1/5, 2/5 base curved, terminal 3/5 dilated into a band-shaped distal seminal chamber (Figure 4B).

Holandric: testis sacs two pairs, in X-XI, developed, separated on ventrum, second pair enclosing first pair of seminal vesicle. Seminal vesicles paired in XI-XII, small. Prostate glands developed, extending from 0.5XVI-0.67XX, composed of three parts. The first two parts are bigger than the last one, which is finger-shaped. Prostatic duct inverted U-shaped. No accessory glands present.

LOCALITY AND HABITAT: The specimens were collected in brown forest soil under the roadside forests of Diaoluo Mountain, Hainan province, China.

REMARKS: In comparison to the other species of the morrisi-group reported from China and Southeast Asia (Sims & Easton, 1972), *Amynthus lingshuiensis* sp. nov. is somewhat similar to *Amynthus hainanicus* (Chen, 1938) in having spermathecal pores in 5/6 and 6/7, a diverticulum longer than main pouch, and a thin-walled seminal

chamber. However, it is easy to distinguish *Amyntas lingshuiensis* sp. nov. from *Amyntas hainanicus* (character states of *A. lingshuiensis* given) by the larger body size, two pairs of papillae in 19/20 and 20/21, the larger interval spacing between spermathecal pores of a segment, and the lack of I-shaped depression in the male field. *Amyntas hainanicus* has an I-shaped depression on ventral side of 1/2XVII-1/2XIX which is glandular in appearance and the male pore is on the inner wall of the depression.

A comparison of characters between this new species and other similar species with two pairs of spermathecal pore in 5/6 and 6/7 collected from Hainan is given in Table 1.

## DISCUSSION

The four new species described above belong to the *morrissi*-species group, which is defined by the following attributes: spermathecal pores intersegmental; first spermathecal pores at 5/6; two thecal segments; bithecate (holandric) (Sims & Easton, 1972).

Among the 30 members of the *morrissi*-group listed in Sims & Easton (1972), the following species are known to occur in China: *A. choeinus* (Michaelsen, 1927), *A. dignus* (Chen, 1946), *A. gravis* (Chen, 1946), *A. hainanicus* (Chen, 1938), *A. incongruous* (Chen, 1933), *A. insulae* (Beddard, 1896), *A. lacinatus* (Chen, 1946), *A. lubricatus* (Chen, 1936), *A. monoserialis* (Chen, 1938), *A. morrissi* (Beddard, 1892), *A. oculatus* (Chen, 1938), *A. puerilis* (Chen, 1938), *A. sapinianus* (Chen, 1946), *A. sinuosus* (Chen, 1938), *A. tripunctus* (Chen, 1946), and *A. variens* (Chen, 1938). A comparison of the new species and the ones resembling them most closely is provided under Remarks for each new species. After the revision of Sims & Easton (1972), two additional species of the *morrissi*-group were recorded from China, namely *A. nanulus* (Chen et Yang, 1975) and *A. parvus* (Chen & Xu, 1977). However, they are both very different from the four new species described here.

*Amyntas morrissi*, a common peregrine species that was also used to name the *morrissi*-group, is rather unique due to the following characters:

- (1) The colour is dark grey or slight grey with some violet tinge on anterior-dorsal side, brownish grey or dark buff grey on posterior-dorsal side, grayish ventrally;
- (2) A narrow zone at anterior edge of XIV and at posterior edge of XVI;
- (3) Two small round flat-topped male region papillae, one in front and another behind the setal zone;
- (4) Each pair of testis-sacs is entirely separated;
- (5) The diverticulum is slender, tube-like, a little shorter than the main part, its duct occupying one third the entire length, slightly larger and roundish at end;
- (6) The whitish, stalked gland in a place close to the external genital papillae.

In comparison with *A. morrissi*, three of the four new species lack pigmentation, indicating that they live in deeper layers with low organic content. The most remarkable character of these new species is the arrangement of the big papillae which may be related to their mating behaviour.

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